Northern CIRCUIT

Spring 1969

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Editor — M. V. DUFFEY

Associate Editor — J. H. GOSSELIN

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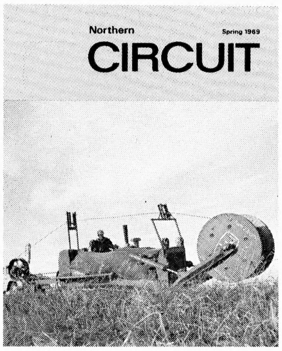


Northern Electric cable goes underground at Forest Lawn, south of Calgary. The operation is part of Alberta Government Telephones' continuing rural buried cable program which, when completed, will provide Alberta with one of the most modern rural telephone networks in Canada.

Robots: Machines that resemble men

by J.E. Mann

Movies, television and science fiction have given robots the awe-inspiring reputation of being machines that lumber about uttering strident, ominous warnings, displaying the tortuous convolutions of their inner "minds" through arrays of blinking lights and electronic beeps. They appear as hybrid creatures of metal and complex circuitry which perform superhuman feats, not all of which are predictable.

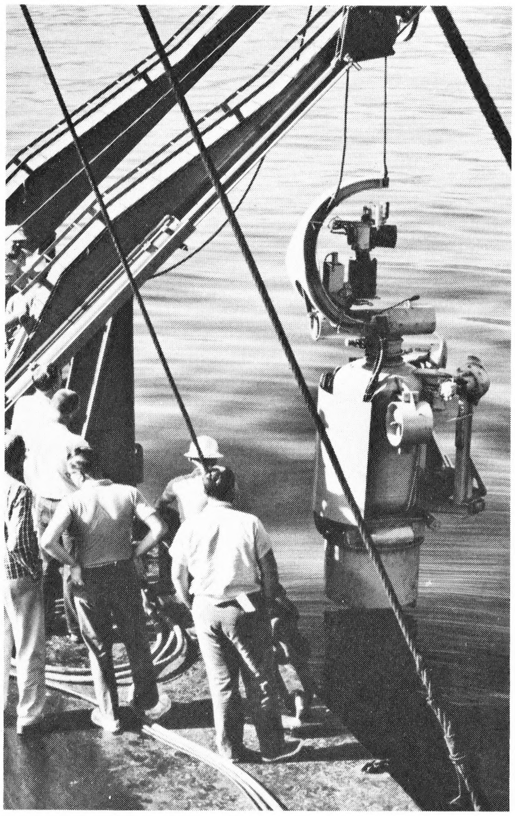
Invariably, they are endowed with strength, determination and untiring devotion to a programmed task — yet, paradoxically, their loyalty is fickle or doubtful at best. And so it is never certain whether their human masters might not become their slaves.

This image is difficult to change and has been with us ever since Czech playwright Karel Capek introduced robots in his play *R.U.R.* back in 1921. His mechanical monsters first replaced men as factory workers and eventually took over the world. Their image has been tarnished to this day.

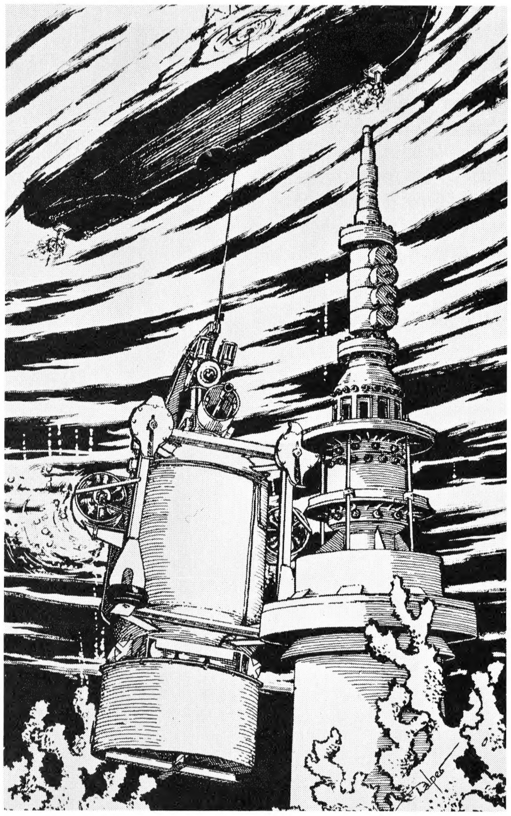
But whether we like it or not, robots are here to stay. They are with us in industry, in laboratories, in space probes, beneath the oceans or where men fear to tread because of environmental hazards.

Unlike automated machinery which is stationary and has been with us for some time, the modern robot can move from job to job, and can be programmed to perform tasks on its own, or with minimal supervision.

Proponents of robot technology are looking beyond the immediate future and speak of machines that truly mimic man. To them it will be a world of bio-



1 - *This Shell Oil Company robot is being lowered into the sea from a drilling ship in a test off the California Coast.*



2 - *An artist's conception of the key components of a new drilling completion and re-entry system by Shell Oil Company for offshore oil and gas wells shows the operation of the robot in the previous photograph. At left, the robot manoeuvres into position with its propellors on either side. It mounts on the circular tracks of the well-head at right, travels around the well-head and uses nose-like socket wrench to turn lock screws which attach and detach underwater equipment. Above is a special drilling ship, Shell's Eureka, equipped with automatically controlled fore and aft propellors that hold the ship over a fixed position without use of anchors. The robot has a television camera for short-range location of the well-head, and sonar for long-range location.*

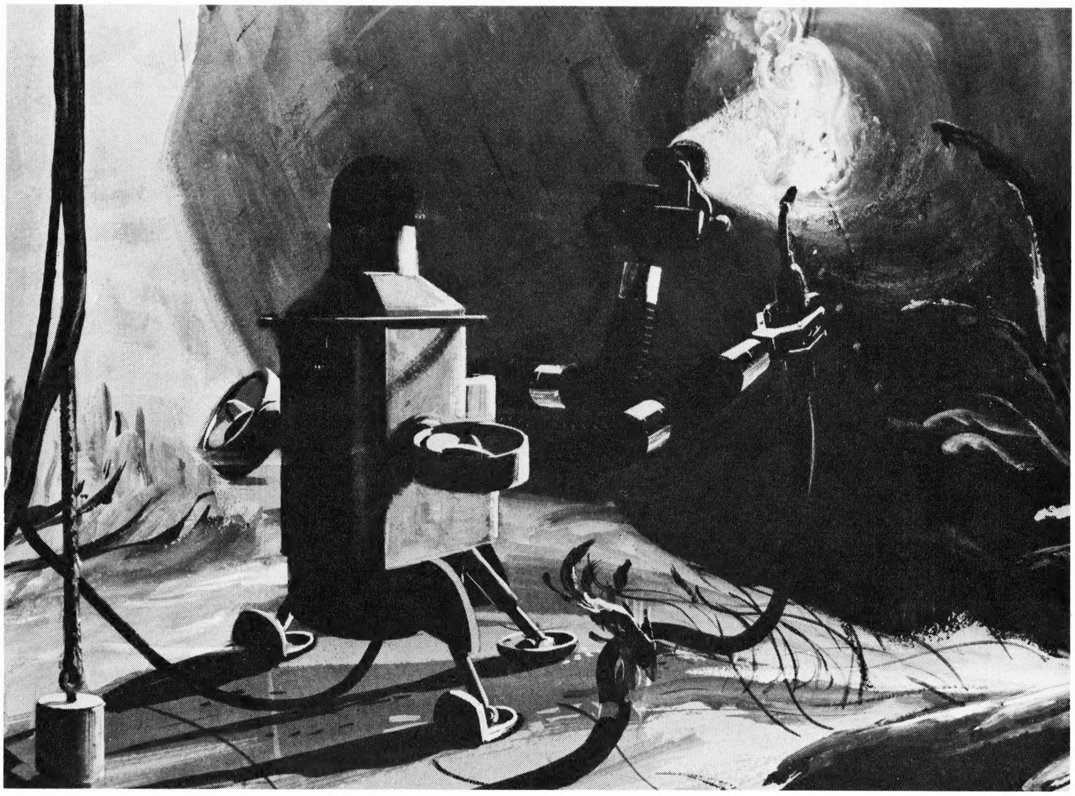
machines with highly developed senses which could, for example, "smell" the quality of a perfume or an industrial soap or "listen" to and transcribe dictation or voiced instructions. Many disciplines would be involved. The talents of engineers, scientists, chemists, physicists, mathematicians, even psychologists, will all be needed. The field itself is difficult to describe and a new vocabulary is in the making. The bio-robots of tomorrow will indeed be a new breed of machines that will do man's bidding with almost frightening agility and efficiency, and may display the first elements of a "machine intelligence" that would include adaptive or self-learning capabilities.

For the "common garden variety" robot already with us, the demands are simpler. Representative of the type of robot in use in industry today is the "Versatran" by the AMF Division of American Machine and Foundry Co. In one application, this machine untiringly delivers steel billets, weighing 4 lbs and heated to 2,200°F, to a 1,300-ton forging press, where each slug is stamped into a gear blank. Over 500 blanks are forged per hour in this robot-assisted production line at an auto transmission plant in the U.S.

This robot comes in "point-to-point" and "continuous path" versions that can be re-programmed for the handling of various parts. In the above case the robot automatically senses the hot billet's position, picks it up and places it into the primary-operation die position, after first determining that the press is open and clear. It then signals the press to operate and the billet is pancaked. The robot's gripper fingers, which have remained in the die area, then grasp the rounded billet and transfer it into the second die position and the press is again cycled. The forged gear blank is then ejected from the die area, the robot checks that the press is clear, and then repeats the operation on the next billet. Automatic programming permits 550 such 4-lb pieces to be produced per hour on an around-the-clock basis — no coffee breaks needed.

The big attraction in using such equipment is that men can be freed for other assignments and it takes the drudgery out of assembly line jobs. According to the developers of the equipment, in a three-shift automotive industry installation the robot can realize a gross labour saving that is measured in millions of dollars.

While robots are not cheap, (about $18 - 20,000), they are finding use in paint spraying of automotive parts, in



3 - *Artist's conception of Shell Oil Company's Mr. Unumo, successor to earlier robot dubbed Mr. Mobot. The new man/machine system will be able to do more complex jobs. Here it's depicted using a cutting torch on a shipwreck.*

conveyor tracking applications and in handling bricks, to give a few examples. At the Burns Brick Co. in Macon, Georgia, two Versatran robots are used to arrange bricks on a kiln car at a rate of up to 10,000 per hour, almost twice the speed formerly possible.

Other robots are working with arm and torso action displaced 90 degrees or more to boost production-line speeds. Still others, including some with horizontal columns, or pressurized, shielded or cooled units for special applications, are used.

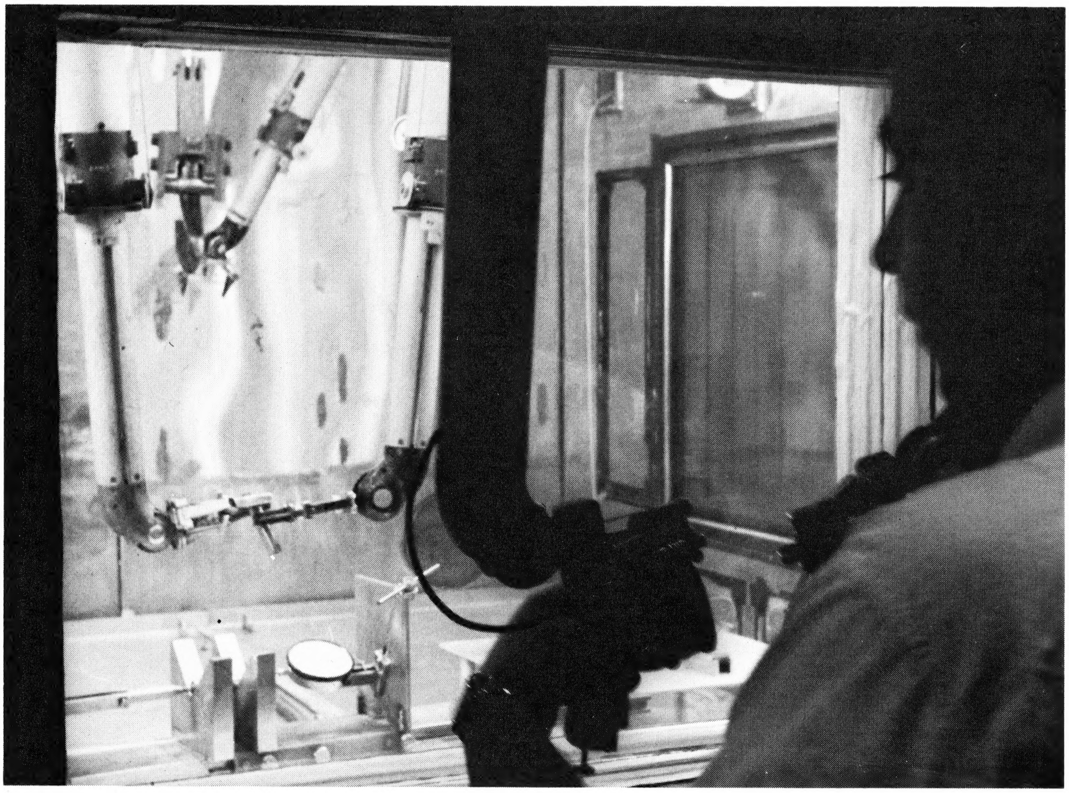
To teach a robot such as the Versatran, a 12-position program can be used. The robot is programmed to perform a specific job, such as feeding a stamping machine, and then can be moved to another location and quickly re-programmed for a different task. To establish a program, the operator "walks" the robot through the sequence it is to carry out. At each position the location of the machine is stored in the robot's memory by adjusting potentiometers for horizontal, vertical and swing axes. Once the position has been stored, any operational commands for that point are recorded on an electrical-matrix pinboard. When the program is initiated, the robot will move automatically through the twelve positions carrying out various commands.

Another major builder of industrial robots is Unimation Inc. of Bethel, Connecticut. It supplies a machine which positions an object by rotating its boom about horizontal and vertical axes and by extending and withdrawing a boom assembly very much like a human hand reaching for something. Orientation of an object clamped in the robot's hand is accomplished by rotation of the hand about two perpendicular axes, giving wrist and bending motion.

One Unimation robot has been applied to operating a lathe, and other machines are being used to lift and move materials to and from machines. The Caterpillar Tractor Co. uses such a robot to feed steel pins into furnaces, a task that workmen previously performed with long-handled tongs. In fact, robots have distinguished themselves as "willing" workers, especially in areas where high temperature, high noise levels or radiation are encountered.

In the nuclear power field, remote handling devices — a form of robot arms and hands — have distinguished themselves as safe and efficient means of handling radioactive materials, and the experience gained here will undoubtedly be of value for the development of the future bio-robots.

It is apparent that the industrial robots



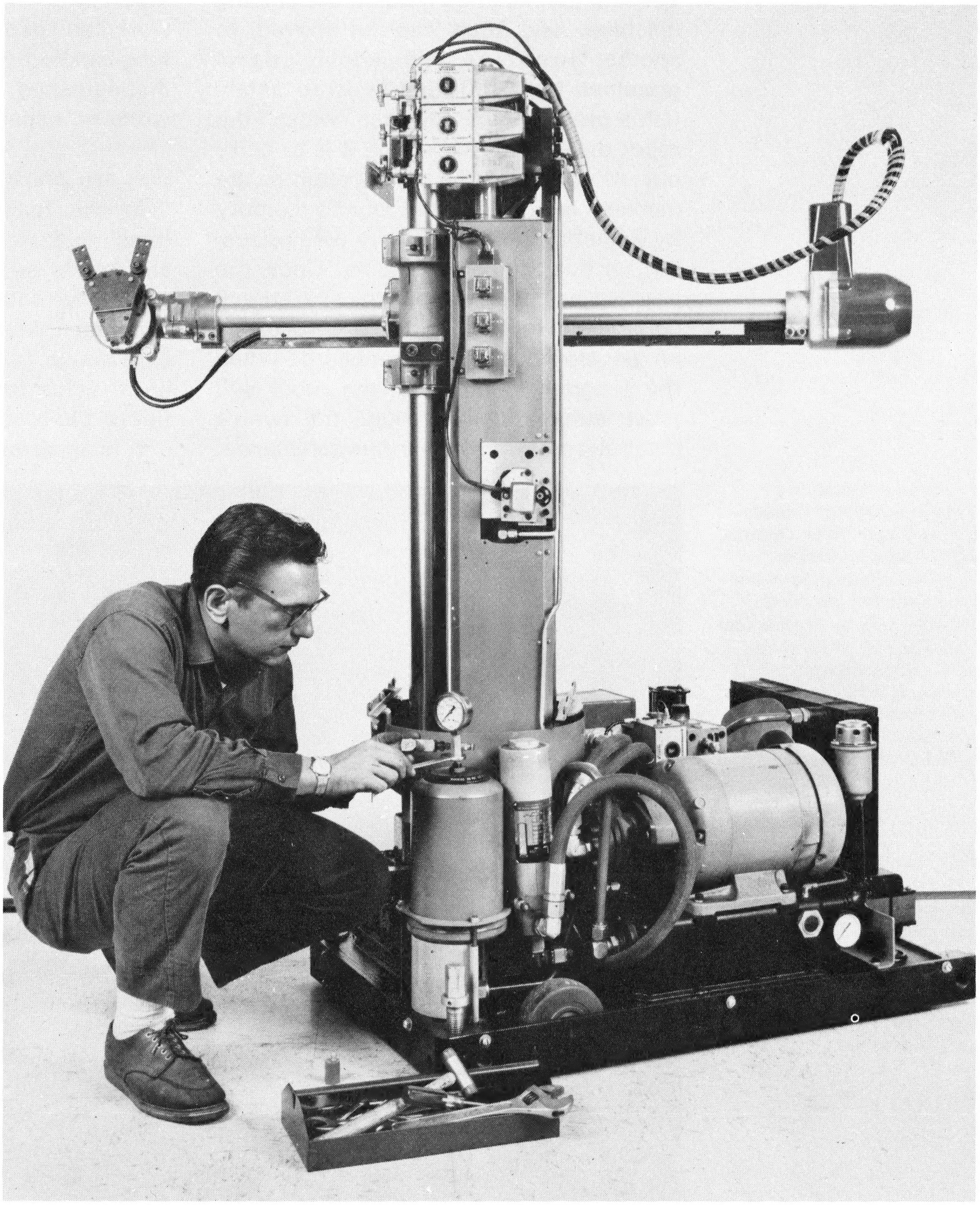
4 - *Robot application by Atomic Energy of Canada Ltd. at Chalk River, Ontario places safe operating distance between man and hazardous environment. Movement is by mechanical transmission of force in most cases. Newer approach is to use systems with electronic/electrical command link between man and machine.*

of today are merely a beginning and the next generation of machines will be more versatile and more "human" . . . at least in terms of manipulative capability.

Even for present generation robots the future looks bright. In the United States, there are about 140 machines in use, but the two leading manufacturers expect to sell, rent or lease about 5,000 industrial robots by 1972, according to one source. By then the robots will be cued by computers and sophisticated programming to give them additional capabilities.

To live up to the established image, robots are being developed to help you and me in our everyday lives. In fact household robots that could take over dishwashing, bed making and cleaning chores around the house may be with us within ten years, if enough money and time are spent on their development. Work has already been done in this field at the University of Sheffield in England.

Some years ago Prof. M.W. Thring delineated such a domestic robot's work as consisting of recognizing objects, picking them up, handling them and putting them down in the right places. This means that work being done in other fields, such as the development of flexible and sensitive hands, will be applied to the household robot. However, means of moving the robot around



5 - *"Versatran" programmable industrial robot provides accurate, high-speed "worker" which can be maintained and repaired by user plant personnel. Potentiometer panel at top of console hinges up for access to circuit boards, other components.*

the house, up and down stairs, as well as a means of recognizing objects and establishing movements to deal with them, will have to be developed.

Some years ago Johns Hopkins University developed a mobile automaton that survived entirely on its own for as long as 21 hours. This particular robot was a squat, ugly machine only 18 inches in diameter. It could be seen moving up and down the hallways searching for wall plugs from which to recharge its batteries. A bumper at its front was equipped with sensors which signalled the presence of an obstacle. The machine backed off, turned to avoid obstacles or falling down stairs. During its operational period, it continuously moved around the halls and fed from four electrical outlets about 25 times. This machine is considered only a first step in the development of an adaptive robot capable of adjusting to changing environments and conditions.

The challenge of imbuing robots with a learning ability has fired the imagination of designers and it is no longer a question of whether it is possible to build a machine that can learn, but rather one of how best to do it.

One of the most interesting applications of a robot was the Shell Oil Company's Mr. Mobot. It first went to sea in 1963 and was used to service undersea oilwells 250 feet below. The 14-foot robot is equipped with "arms" that can handle tools to adjust equipment on the underwater well-heads. For eyes, it relies on a television camera whose signals are transmitted via cable to a television monitor on board ship. The robot's "master" sits at a control console aboard ship, and by manipulating appropriate switches the robot goes to work at the sea bottom.

Since divers have difficulty operating below certain depths, the robot is very useful. It can operate virtually in any depth, and is not subject to physical stresses. In contrast, the best equipped divers are limited to depths of 200 feet and their efficiency is considerably curtailed since they can work only for a few minutes at this depth. Shell found the robot particularly useful on the Pacific coast where the sea floor slopes off rapidly to more than 300 feet. The robot was built by the Hughes Aircraft Co. and weighs 7,000 lbs. in the air, and about 3,800 lbs. when submerged. It has air tanks to give it more buoyancy in water, and it is lowered from the drilling ship by a cable attached to a crane. Attached to the cable is a line which carries the electronic commands from the robot's operator.

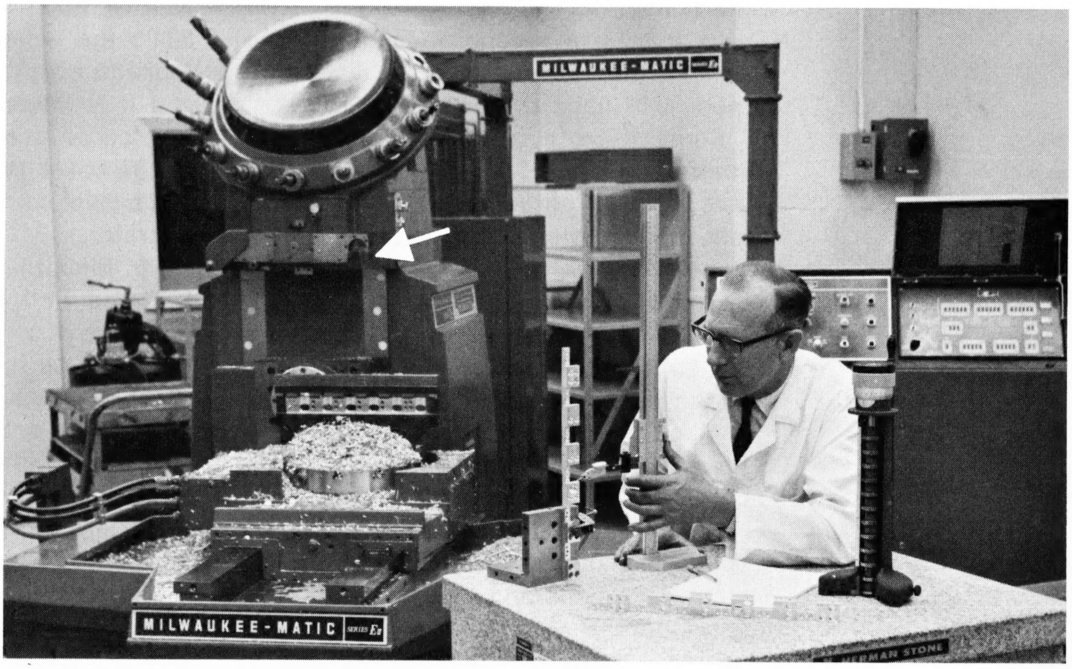
Mr. Mobot is not without some human traits as well. Hearing is provided by a sonar device which helps him find his objective as far as 1,400 ft. away. He is also equipped with a hydrophone which relays the sound it makes in contact with the well-head. For direction, he relies on a gyro compass which helps the operator on board ship to steer the robot to his objective.

The television camera provides sight and a battery of lights helps to brighten things. To handle the work, the robot's arm can be extended two feet and can be fitted with either a socket wrench or grip. With the socket, Mr. Mobot can turn lock screws while with a grip he can operate a valve, and attach control hoses and guide lines.

Since robots are expected to show their mettle in places that men cannot reach, their dexterity in handling objects is important. To control a robot remotely, the new science of telechirics has come into existence. The term has been coined by Dr. John W. Clark of Battelle Memorial Institute in Ohio, and stems from the Greek words for "distant" and "hands". Telechiric systems combine man's versatility and decision-making ability with a machine's ruggedness, invulnerability and mechanical prowess. They are different from automatic systems, according to Dr. Clark. While the automatic system takes the place of man, performing operations in a programmed and predetermined manner, the telechiric systems allow man to operate a set of tools — perhaps via the robot — as if he were holding them in his own hands. First examples of such systems can be found in the nuclear field where manipulators are used to handle materials remotely from behind heavy shielded walls.

Generally, telechiric systems are designed to carry out mechanically the same tasks that could be done with human hands and senses if it were not for the hostile environment involved.

6 - *At Northern Electric's Montreal Works, this numerical controlled machining centre acts as milling machine, jig borer, drill press, rotary head miller and tapping machine. The robot arm (see arrow) changes tools automatically so machine can perform various functions.*



In effect, the facilities of the human body are extended electrically and mechanically to almost any distance. A well-designed telechiric system would extend man's eyes, hands and feet with somewhat equivalent mechanical devices, and electronically enable his nervous system to communicate over the required distance. The feasibility of such a system has been proven and the technology involved is well established according to Battelle.

While we are just on the verge of an exploding technology in robot machinery, many express fears that the advent of such machines and systems might displace large numbers of people, endangering their livelihood. There's little doubt that technological change can have a profound effect on individuals. History has proven that innovations frequently create more jobs than they eliminate, the auto industry being a classical example. But the men in automation are keenly aware of the problems we face and their concern was well summarized at a conference on employment problems of automation and advanced technology in Geneva in 1964. There, Mr. John I. Snider Jr., chairman and president of U.S. Industries Inc. and co-chairman of the American Foundation on Automation and Employment said that "the great potential of automation and corollary technical advances will not be used to centralize, homogenize categorize or dehumanize mankind. Instead — at least in the western world — automation will be used to enhance the dignity and wellbeing of the individual as a dynamic and determinate force in the course of affairs of this planet".

While many see the emergence of robots with mixed emotions, our times are characterized by the attempt to both mechanize humans and to humanize machines. Having reached this point in his development, man must concentrate on ways and means of improving the quality of human living. It is to be hoped that robots can be a positive factor in such improvement.

Toronto subway goes suburban

by Derrick Edwards

On the eleventh of May 1968, Toronto's subway ceased being merely an urban rapid transit system and became suburban as well. On that date, the six-mile extension to the Bloor - Danforth line opened to provide the link which connects the suburban community of Scarborough on the east to Etobicoke on the west. For commuters from these suburbs, TTC now offers a welcome alternative to congested expressway driving with its attendant downtown parking problem.

For Toronto's subway engineers, arriving at this solution was no easy task. All sorts of difficulties had to be overcome. The Commission should be lauded, therefore, for their solutions: for their architectural designs which have achieved a delicate balance between aesthetic appeal and practical utility; for their substations which, because they are within view of highrise apartments, were fitted with pre-cast T-bar roofs to afford a pleasant view from above; for their efforts to contain substation noise within TTC property by limiting the maximum noise level of purchased equipment and by using sound absorptive techniques in the construction of substation enclosure walls.

It was in the construction of these substations that Northern Electric was given an opportunity to play an important role. The substations provide 570-volt DC traction power from the available utility AC sources at 27,600 volts and 13,800 volts.

Working in conjunction with TTC and 33 equipment suppliers, Northern Electric designed, manufactured and installed equipment for three 3800 KW, 27,600 volt substations at Islington, Prince Edward and Victoria Park; one 3800 KW, 13,800 volt substation at Jane Street; and a 2500 KW addition to the existing Indian Grove substation. Northern also participated in the re-location and modification of Woodbine substation now located at Warden (featured in NORTHERN CIRCUIT, issue of spring 1966).

Through use of the Critical Path Method, Northern scheduled the activities of its numerous suppliers so that equipment availability corresponded with site and positioning readiness. Company field supervisors visited suppliers regularly throughout the manufacturing interval to maintain a close check on progress and quality of equipment.

Substation Equipment

The substations comprise the following major equipment: AC Switchgear, Rectifier Transformers, Rectifiers, Station Auxiliary Transformer, DC Switchgear and Control Board. The AC Switchgear, Rectifier Transformers, Auxiliary Transformer and Rectifiers are located at grade level surrounded by a 16-foot high wall and the DC Switchgear and Control Board are located in the basement control room immediately below the substation pad. The control room also houses the batteries, supervisory control and miscellaneous auxiliary equipment.

AC Switchgear

Rapid transit operations depend heavily on continuity of the power flowing from the rectifier substations. For this reason, TTC requested that AC power be brought to each substation over two separate H.V. circuits by the hydro utility concerned. To handle this duplicate feed, the switchgear is designed as two identical incoming circuits, each with its own line circuit breaker. These can be isolated by means of disconnect switches which were provided in the 27,600 volt equipment, or by mechanical disconnection, as was the case for the 13,800 volt equipment. Each line has its own set of CTs, PTs and protective devices. The AC bus, however, is joined on the load side of the line circuit breakers to become a common bus for metering and for supply to the rectifier branches and station auxiliary supply transformer. The incoming line circuit breakers are electrically interlocked so that only one incoming supply can be utilized at any one time. The AC portion of the rectifier branches is made up of electrically operated load interrupter switches which are operated sequentially with the rectifier DC breakers so that the switches break magnetizing current only.

The 27,600 volt AC switchgear lineup measures 55′ long by 27′6″ wide and 13′6″ high. It is fed from underground and is throat connected to the two rectifier transformers and station service transformer.

The 27,600 volt switchgear was designed and manufactured by S&C Electric; the 13,800 volt switchgear by Pioneer Electric and S&C.

Rectifier Transformers

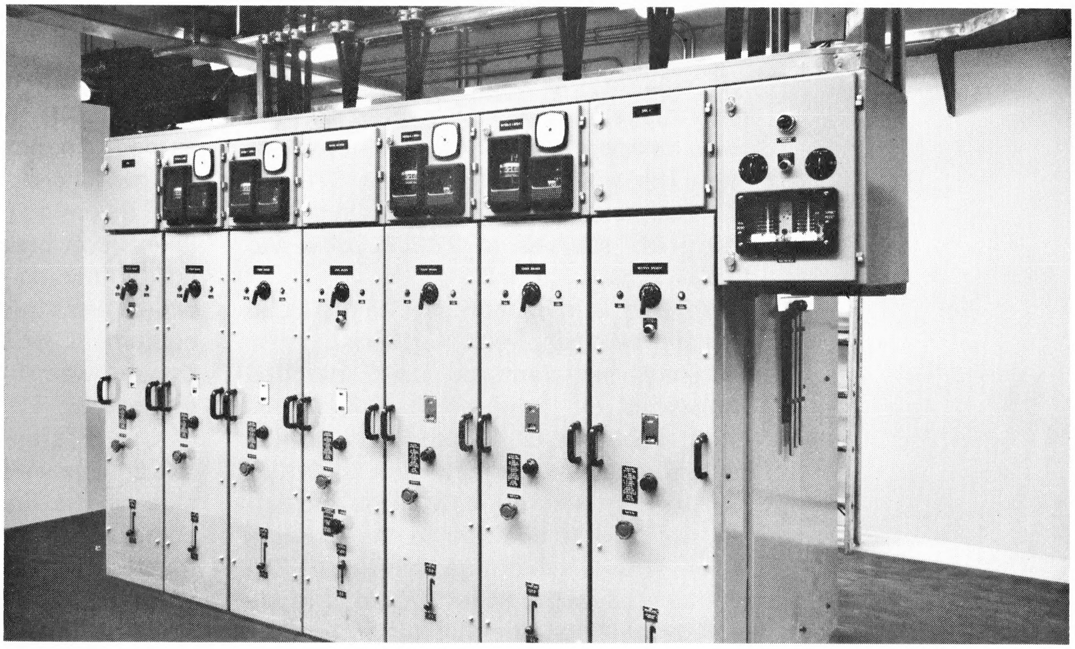
There are two 2085 KVA oil-filled, naturally cooled, outdoor type rectifier transformers at each station. The primary winding is delta connected, while the two secondary windings are delta and wye connected respectively. When used with the series bridge rectifier, the output is 12-pulse DC at 570 volts. Protective devices include oil thermometer with alarm contacts, winding temperature device with alarm contacts and a 2-stage Buchholz gas detector relay with both alarm and trip contacts. The rectifier transformers are close-coupled to the AC switchgear and rectifier houses by throat connections. The specification called for a maximum sound level of 60 db when measured according to NEMA TR1 standards, thus ensuring quiet operation even at peak load periods.

A compact transformer layout was necessitated by the space limitations within the substations. Hackbridge and Hewittic achieved a very compact design, made possible by ingenious space-saving features. Typical of these was the decision to place high voltage bushings in the headers of the cooling radiators, thereby minimizing throat dimensions.

Silicon Rectifiers

The silicon rectifiers are rated at 1900 KW each at 570 volts DC and are naturally air-cooled. The individual diodes are silicon wafer of both the PN and NP types, with the junction hermetically sealed within a glass metal housing. They are mounted directly onto finned aluminum extrusions forming the rectifier bus bars which also dissipate the heat. There are 360 diodes per rectifier, each protected by an H.R.C. fuse, especially designed to co-ordinate with the diode curve. Each H.R.C. fuse is paralleled by a striker-pin fuse which actuates a microswitch connected to the local and remote alarm systems.

Traction rectifiers are called upon to supply the large currents demanded by the DC motors during train acceleration. The Hackbridge and Hewittic rectifiers were designed to carry a continuous 100% load with one diode in each bridge leg out of action and operate in this manner without exceeding 45 deg. C. above an ambient temperature of 35 deg. C. Still, with one diode per bridge



1 - *Typical DC metalclad switchboard with truck-mounted drawout breakers. The mass trip feature can be seen at the right end.*

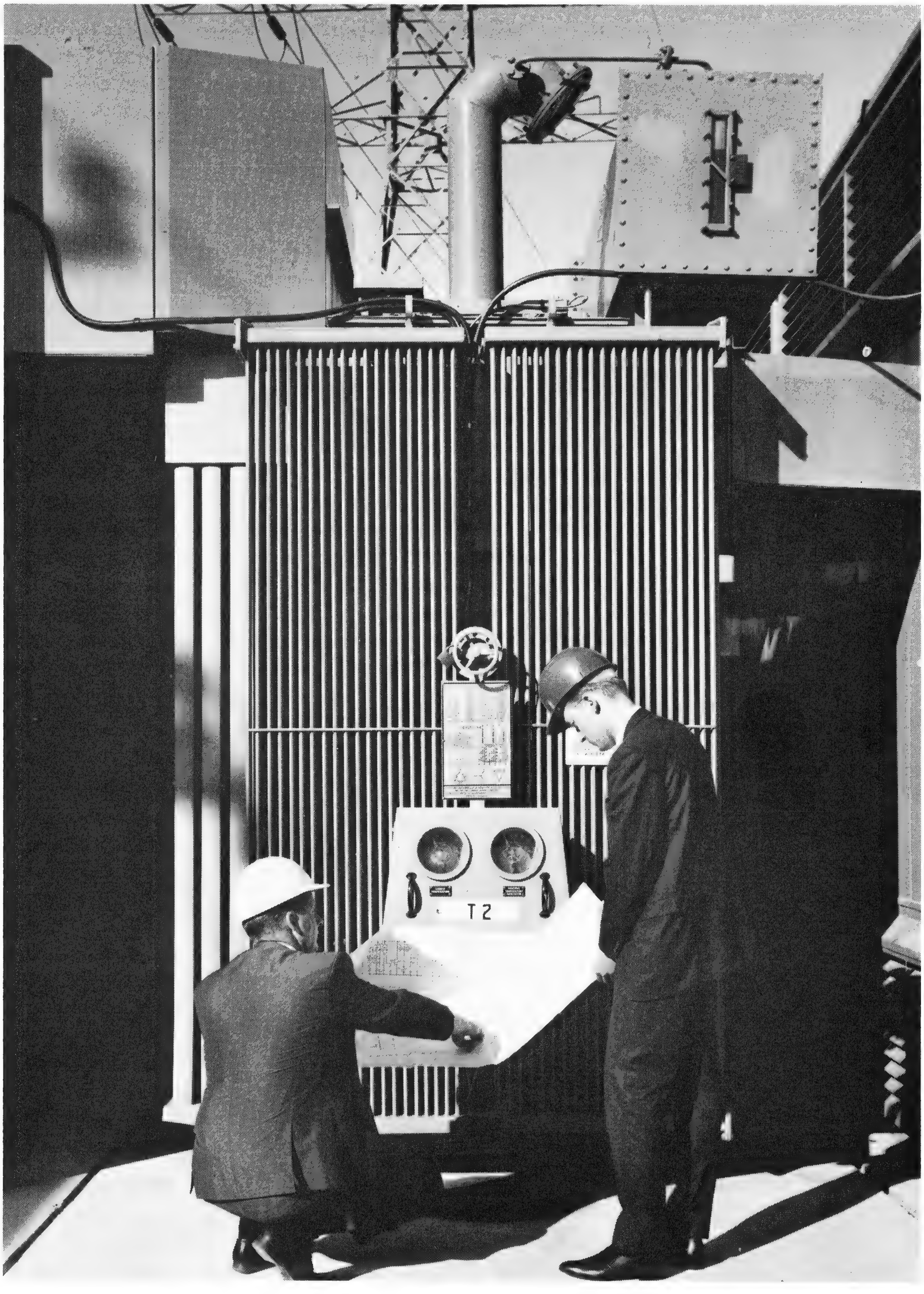
leg inoperable, the rectifier will safely supply: 150% load for 2 hours following continuous 100% load; 300% load for 5 minutes following continuous 100% load; 400% load for 2 minutes following continuous 100% load.

The rectifiers are protected by surge suppressors, surge diverters, hole storage capacitors and overtemperature devices. They are installed in outdoor houses which have automatically controlled ventilating louvres and heaters to provide safe ambient operating temperatures both summer and winter.

DC Switchgear

The DC switchgear comprises a lineup of rectifier and feeder semi-high speed circuit breakers mounted on withdrawable trucks. The trucks are housed in a sheet steel enclosure complete with metal shutters, which operate automatically when the breaker truck is withdrawn, preventing access to live metal.

The circuit breakers mounted on the



2 - *TTC and Northern Electric engineers discuss the Hewittic 2085 KVA rectifier transformer in the background. Throat connections can be clearly seen. To the left is the 34.5 KV AC switchgear; rectifier house appears on the right.*

trucks have silver-plated spring loaded contact fingers which engage with tongues in the housing when the truck is fully home, thus completing the main current carrying connections. The spring loaded multifinger contacts are self-aligning and self-loading so that no additional clamping is necessary.

The bus work is arranged so that the rectifier breakers feed a common bus from which all feeder breakers derive power.

Control components are mounted both on the truck and in the housing, interconnections being made by phosphor bronze silver-plated spring contacts. These contacts have a long wiping action so that they are still connected when the truck is withdrawn to the test position.

The rectifier breakers are equipped for instantaneous reverse current and time limit overcurrent tripping, while the feeder breakers are equipped for rate of rise of current and inverse time overcurrent tripping. The feeder breakers have automatic reclosure capability, as discussed further on in this article.

Control Scheme

The control scheme is one of the most sophisticated ever devised for a traction substation. TTC specified the functional parameters for the scheme, and the design was achieved by a team of Hackbridge and Hewittic and Northern Electric engineers. In this work, Hackbridge's global experience with rectifier control, and Northern's experience with Canadian switchgear practice, was fully utilized.

3 - *These indoor rectifiers at the Indian Grove substation are similar to the ones supplied for other substations along the line.*

The fully automated substations are normally unmanned, yet the TTC power control operator at the Transit Control Centre, several miles distant, can tell at a glance the total status of the stations. This is made possible by a supervisory remote control system, which also enables remote operation of substation equipment at any time.

In the case of a supervisory breakdown, any station can be operated locally. Supervisory can be locked out by control switches at each substation so that equipment maintenance can be carried out without danger of remote activation.

In addition to manual operation, several automatic operating features are included.

Auto-Transfer

In the event of failure of the preferred incoming supply, an under-voltage relay sets up a transfer circuit which is delayed for a few seconds to allow for the possibility that hydro power might be restored immediately. If restoration is not accomplished, the transfer circuit trips the preferred line circuit breaker after which the circuit breaker in the standby line is closed automatically. This process does not restore; return of the substation to the preferred supply will be accomplished via supervisory control after consultation with the hydro power control operator.

Automatic Shutdown

If a fault develops in one of the rectifier/transformer branches, a shutdown sequence is initiated by which the line circuit breaker is opened, followed by the DC rectifier breaker, then the load interrupter switch in the affected branch. This action is followed by the reclosure of the line circuit breaker which restores power to the unaffected branch and to station services. Simultaneously, an alarm is sent to supervisory and the faulty branch is locked out. The faulty branch cannot be put back into service until maintenance staff repair the fault and reset the lockout relay located at the station.

Automatic Reclosure of Feeder Breakers

If a Feeder Breaker has tripped either on rate of rise of current or inverse overcurrent, it will be reclosed automatically after a pre-set time delay, provided that the track and feeder are in a healthy condition. To detect any abnormality in the traction power system, a load measuring circuit senses voltage, or checks the resistance of the feeder circuit, before an automatic reclosure is initiated. The time delay is adjustable, so that sufficient cool-off time is allowed after a trip operation before power is restored to the contact rail.

Ground Fault Protection

As the D.C. switchgear is in a metallic housing, a suitable means for ground fault protection had to be found. The chosen method was to ground the switchboard at one point only, through an H.R.C. fuse. A transductor is also used around the ground lead to detect low values of fault current and activate a priority alarm. With the occurrence of a large ground fault, the H.R.C. fuse is blown, initiating a mass trip.

Mass Trip

When the ground fault H.R.C. fuse is blown, a striker pin fuse in parallel with it closes a microswitch, picking up the mass trip relay which seals itself in mechanically. The line circuit breaker is tripped, all DC feeder breakers are tripped and locked out, and both rectifier branches are isolated and locked out. The line circuit breaker then recloses automatically, maintaining the auxiliary supplies and essential station services.

It is not possible to restore DC power until the fault is cleared, the ground fault fuse is replaced, the mass trip relay is reset and the rectifier branch lockout relays are reset.

Fail Safe Supplies

Some of the control and protection circuits for the equipment rely on AC power, and because these are vital to substation operation, it is necessary to have two supplies, the normal one from station service transformers and a standby from a remote location on a different main feeder. These are combined at an Asco Electric automatic transfer switch which changes over on supply failure. When the normal supply is restored, the switch automatically returns to position after an adjustable time delay.

Interlocking

In keeping with the industry's high concern for personnel and operator safety, Northern Electric, in collaboration with its suppliers, devised an interlocking scheme which necessitates complete isolation of any section of the switchgear before allowing access, for maintenance or any other purpose.

Installation

During the installation of the substation equipment by TTC forces, Northern Electric and Hackbridge and Hewittic field supervisors worked closely with the customer's engineering and operating staff. Delivery of equipment to the site had to be very carefully co-ordinated by all parties. The only method of positioning the equipment was to crane-lift it over the enclosure walls.

TTC forces were responsible for all the wiring inter-connections between equipment, and this work was co-ordinated by Northern Electric personnel who also were responsible for checking out circuits. Hackbridge and Hewittic participated in the testing and commissioning program and conducted short circuit tests on site to verify relay settings and automatic operating sequences.

Spectroscopy replaces wet chemical analysis

by Norman S. Morris

The discovery of the composition of light and of the optical spectra by Sir Isaac Newton (1642-1727) soon prompted other scientists to use similar techniques for determining the composition of matter. By studying and measuring the light or radiation spectra of burning or incandescent samples, they gave birth to a new scientific technique known as spectroscopy.

With it, modern scientists achieve astonishingly accurate chemical analyses, so much so, that spectral analysis is rapidly displacing the more conventional wet chemical analysis. Everywhere, the wet chemical laboratory's familiar test tubes, beakers and retorts are giving way to impressive cabinet-enclosed spectroscopes.

Intent on turning out high quality products, Northern Electric's Montreal Works has equipped its engineering laboratories with a variety of spectroscopic instruments in recent years.

The introduction, after the Second World War, of new products such as the transistor, modern electron tubes and the sealed contact (ferreed switch) to its product portfolio caused this move toward more precise analytical methods. Improved capabilities for trace component detection and greater degrees of accuracy for impurity measurement were becoming necessary. These could only be obtained by the addition of a spectroscopy laboratory to the existing wet-type facilities.

On the other hand, and in spite of the rapid addition of spectroscopic apparatus, the wet chemical laboratory still exists and now complements the newer facilities.

In some ways, the wet chemical laboratory has become more specialized. To be specific, it is dedicated to analysis that cannot yet be handled by spectroscopy, and it assists in the establishment of X-Ray fluorescence and atomic absorption methods by preparing or verifying standards. It also serves to confirm spectroscopic methods.

In the end, the wet chemical and the spectroscopic laboratories are acting as a team to produce, in the most economical manner, reliable analytical information to ensure the quality of present and future Northern Electric products.

Evolution rather than revolution marked the change in emphasis from one means of analysis to the other. Twenty years ago, for instance, the plant's wet chemical laboratory was a modest operation. The nature of the products then manufactured by the company seldom called for the precise chemical analysis new products now demand. These were the years when electromechanical devices dominated the telephone switching field.

It will be recalled that, after the war, the most highly developed industrial wet chemical laboratories were usually operated by chemical, drug or food processors, oil refineries, steel mills and other industries whose survival depended on the accurate chemical composition and purity of products.

The stereotype of these laboratories included large areas of open bench space, sinks, fume hoods, analytical balances, heaters, ovens, glassware as complex as it was varied, and impressive rows of chemical bottles and containers.

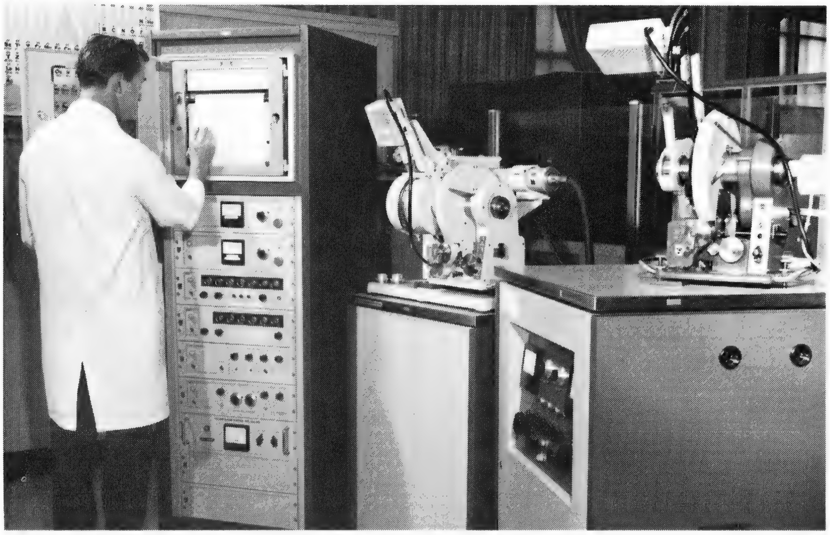
The first major piece of spectrographic equipment purchased by the Montreal Works laboratories was an Associated Electrical Industries MS-3 mass spectrometer. Its zero to 130 mass range makes possible the analysis of gases and of some light hydrocarbons. Until now, however, it has been used

1 - *This mass spectrometer at Northern Electric's Montreal Works ensures the quality of gases.*

mostly as a quality control operation in the production of the sealed contact — a mechanical contact in the voice channel of modern electronic telephone switching systems.

Gas used to flush these glass enclosed switches or contacts is analysed to ensure that the presence of impurities such as oxygen, argon, carbon dioxide and water is kept below acceptable levels. The atmosphere inside the glass bulb must be such that it will not cause the gradual oxidation of the contacts or otherwise poison them. Similarly, the atmosphere in crystal units, diodes, electron tubes and thermistors are studied together with incoming gases and heat treating furnace atmosphere.

Another important piece of equipment, a Philips X-ray fluorescence spectrometer, was acquired as soon as the plant began the production of ferrite devices — the core of temporary memories in electronic telephone switching systems. This spectrometer is used to control the relative quantities of iron,



2 - *Also used is this X-ray fluorescence spectrometer for controlling the quality of major constituents of ferrite and metallic alloys.*

3 - *Minor constituents and impurities are measured to the parts per million on this atomic absorption spectrophotometer.*

manganese and zinc which are the major components of these devices. The use of this laboratory instrument has now been extended to the analysis of other metallic material. In some cases, it also provides an alternative to optical emission analysis.

To supplement X-ray fluorescence, particularly in the case of low concentration alloying elements and impurities, a Unicam SP90 atomic absorption spectrophotometer was obtained. In many cases, this instrument can achieve levels of detection in the low parts per million range. Each element must be determined separately using an atomic spectral lamp specific to that element. This spectrophotometer has been most useful in determining the calcium content of ferrite materials.

As additional spectral lamps are acquired, the use of the instrument is being extended to plating solutions and to metallic raw materials for which wet chemical or optical emission analysis would otherwise be required.

Another valuable instrument in the laboratory is the Beckman GC-5 gas chromatograph. It is equipped with thermal conductivity, helium ionization and hydrogen flame detectors. These make possible the analysis of gases and volatile liquids.

In gas analysis, the helium ionization technique permits low parts per million determinations beyond the range of the mass spectrometer, and it will be particularly useful in the detection of minute traces of oxygen in applications where its presence is undesirable.

The hydrogen flame detector has permitted an extension of laboratory activities into the field of organic chemical analysis for which virtually no facilities have previously been available.

The use of this recently acquired chromatograph has not yet been fully developed by the laboratory. However, it is expected to become one of its most powerful analytical tools.

The possibilities for growth of mass spectrometer applications are limited by the alternative methods which the gas chromatograph now provides. However, the X-ray fluorescence spectrograph, atomic absorption spectrophotometer and gas chromatograph have a promising future. New products just around the corner will no doubt require spectroscopic services to maintain a sound quality position, and more critical applications for current production could necessitate more extensive control programs in which spectroscopy would play a prominent part.

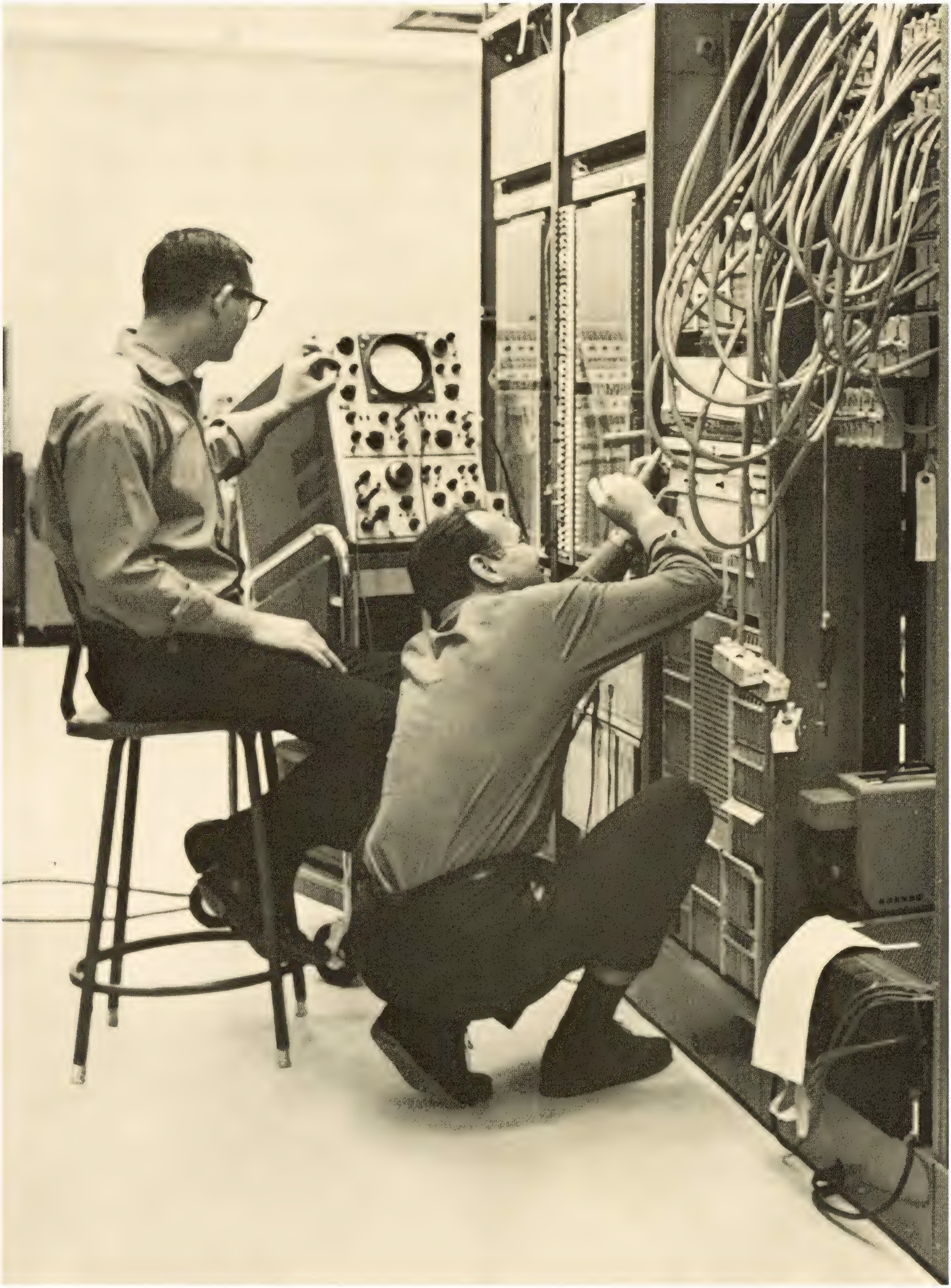
SP - 1:
The first Canadian-designed electronic switching system

by J.H. Gosselin

In today's telephone industry, electronic switching systems are the "in" thing. All over the world, telephone men are clamoring for them. To help satisfy this demand, Northern Electric recently introduced SP-1, the first electronic switching system to be designed in Canada and one that is specifically tailored to the size range most frequently required in this country.

Unlike most of its predecessors, which were conceived for operation in very large or small telecommunications centers, SP-1 has been designed for central offices having as few as 2000 lines, yet can grow to 20,000 lines or more. (For

1 - *Flanked on both sides by mobile test frames, the central processing unit of SP-1 (the heart of its stored program system) is put through its paces prior to field trial installation.*



2 - *Two members of Northern's memory systems development group monitor program store memory operation of the SP-1.*

a more precise and technical definition of capacity, see Table).

Featuring a stored program central control for switching telephone calls, the system offers telephone administrations a high degree of flexibility. For instance, it can be directed to add, adapt or modify certain logical functions by means of program alterations rather than by extensive and expensive equipment or modifications. And advantages of SP-1 are not limited to the fact that it is more economical and reliable than existing electromechanical systems. A major advantage lies in its adaptability to the sophisticated needs of the future.

The system's stored program not only enables the call set-up and supervision logic to be written-in or changed as required, it permits:

- maintenance and diagnostic routines to be scheduled flexibly;
- re-assignment by teletypewriter, and from remote locations, of subscriber directory numbers as and when this is required;
- traffic studies to be programmed and altered to suit unusual conditions,
- and general supervision of an unattended switching office from a central area or remote maintenance center.

Telephone subscribers too will appreciate many of the additional services that can be made available to them by an electronic switching system. The SP-1 can be arranged to provide the following features:

- Speed Calling — placing of calls to frequently called stations by dialing only one or two digits;
- Call Waiting — allowing a subscriber on a busy line the flexibility to transfer to a waiting call, and returning to the initial conversation without the need of an auxiliary key telephone system;
- Three-way Calling — permitting a third party to be added to a conversation already in progress;

Table–
Major Characteristics and Features of SP-1

Size:
a) initial installations: 2,000 — 10,000 lines
b) nominal maximum: 20,000 lines
c) physical capacity: 37,800 lines

System Traffic Capacity: 110,000 ccs* per average busy season busy hour (approx. 3,000 erlangs**)

Call Capacity: 36,000 calls per average busy season busy hour

Reliability: a down-time not exceeding 2 hours in 40 years

Floor Space: less than half that of conventional crossbar switching

Reduction in Operating Expenses: through reduced administration changes and maintenance

Maintenance & Administration Features:
a) automatic trouble indication and diagnosis
b) plug-in repair of solid state components
c) improved permanent signal disposition
d) flexible line and trunk assignment
e) teletypewriter and tape traffic data output
f) automatic call tracing
g) teletypewriter service and trunk

Service Features:
a) immediate ringing
b) local tandem switching
c) direct-in-dialing to a PBX
d) Automatic Number Identification
e) Automatic Message Accounting records stored on magnetic tape

Special Features & Services:
a) Centrex
b) Custom Calling Services
c) Flexibility to add new features easily and economically

Cost: competitive with existing common control systems.

*ccs — 100 call-seconds. A call-second is defined as one call lasting for one second.
**erlang — one erlang equals 36 ccs.

- Call Forwarding — automatically transferring incoming calls to an alternate telephone station of the subscriber's choice.

These services are within the capability of modern electro-mechanical switching systems. However, as such systems depend on the interwiring of relays and other logic devices for a series of operations to process a call, the cost of these unusual services is often prohibitive. With the advent of semiconductor logic and memory devices, electronic switching systems are, in essence, controlled by a specialized computer in which call processing operations are stored in a memory. As most new functions to be provided are likely to require changes in the stored program only, many sophisticated services to the subscribers can be provided economically and rapidly.

The SP-1 electronic switching system is designed to be compatible with standard central office systems, switchboards and desks. Where a demand for special services develops or can be anticipated, the SP-1 can readily be used to replace the existing electro-mechanical switching system. The space-saving features of electronic switching equipment also can be an economic factor when replacing outdated systems. The SP-1 makes use of 7-foot high self-supporting equipment frames which eliminate the need for ladders. The design of framework and equipment makes possible installation of this system in new or existing switchrooms.

For the benefit of both telephone administrations and subscribers, the SP-1 system is very dependable and requires a minimum of maintenance. It was designed for a down-time factor not exceeding two hours in 40-years.

To achieve these qualities, integrated circuits were used wherever feasible, and long-life solid-state devices were specified wherever discrete electronic components were required. Critical apparatus and units, such as the central control, are duplicated and operate in parallel. In the event of failure of a unit, its counterpart can take over with no loss of continuity to the calls in progress.

The system continues to provide telephone service while it performs on-line fault checking routines, makes diagnostic tests that pin-point possible trouble within a unit, and takes corrective action when necessary. A teletypewriter, located in the same office or in a remote location, provides a means for obtaining information from the system in the form of a page printout and for typing information into the system. The active and passive states of major equipment units are indicated on an alarm and display panel.

Northern's SP-1 electronic switching system is the result of several years of intensive development and represents one of the largest projects undertaken by the company's Research and Development Laboratories. The system now has reached the field trial installation stage (in Bell Canada's Britannia NE-5 office near Ottawa) and will be in regular production in less than two years.

Dr. Helen Sawyer Hogg

by M. V. Duffey

An interview with noted astronomer, newspaper columnist, director of Bell Canada and recipient of the Canada Centennial Medal.

1 - *Dr. Helen S. Hogg seated in her office at University of Toronto's David Dunlap Observatory.*

Profile: Dr. Helen S. Hogg was born in Lowell, Mass. and received her Ph.D. in Astronomy from Radcliffe College. She also holds honorary degrees from Mount Holyoke College and the University of Waterloo and was recipient of the Canada Centennial Medal in 1967 and the Medal of Service of the Order of Canada in 1968.

Dr. Hogg is a Fellow of the Royal Society of Canada; past president, Royal Astronomical Society of Canada; past president, American Association of Variable Star Observers; past and first female president, Royal Canadian Institute; past program director for astronomy, National Science Foundation, Washington, D.C.; professor of astronomy, University of Toronto; member, American Astronomical Society; chairman, variable stars in clusters committee, International Astronomical Union; director, Bell Canada.

She came to Canada in 1931 and with her husband, the late Dr. Frank Scott Hogg of Preston, Ont., joined the Dominion Astrophysical Observatory in Victoria, B.C. In 1933, they moved to Richmond Hill, Ont. to participate in the establishment of the University of Toronto's David Dunlap Observatory. At the time of his death in 1951, Dr. Frank Hogg was Director of David Dunlap Observatory, a post he had held since 1946. (Present Director is Dr. Donald A. MacRae).

Dr. Hogg is mother of three children and grandmother of seven. Her elder son is a Ph.D. in astronomy at the National Radio Astronomy Observatory in Greenbank, West Virginia.

Dr. Hogg and Madame Pauline Vanier were elected to the Board of Directors of Bell Canada in March, 1968.

Brisk, icy winds whipped across the grounds of the University of Toronto's David Dunlap Observatory as I emerged from a taxi for an early morning interview with astronomer Dr. Helen Sawyer Hogg. The first signs of winter were in evidence as white patches of snow accumulated in low points on the lawns and along the sides of the winding road that leads to the observatory.

I had arrived a few minutes ahead of schedule and as I awaited the arrival of the eminent scientist whose career has been so interwoven with the establishment and development of this famous observatory, I could not fail but note the hushed, tranquil atmosphere of my surroundings which contrasted sharply with the storm outside, but harmonized with the mood created by the back-lighted photo displays of faraway galaxies and nebulae that line the hall outside the doctor's office.

As the thoughts generated by these magnificent images carried me to one point after another in the vast universe, I heard the heavy front door creak open and realized from a recent photograph I had seen of her that Dr. Hogg had arrived.

For a moment it was difficult to believe that this charming, elderly lady with the friendly smile could be one of the world's foremost authorities on variable stars, an astronomer of international repute, a feature writer on astronomy for the Toronto Daily Star, and a director of one of the largest utilities in North America, Bell Canada. Though she is every one of these, she is also the proud grandmother of seven grandchildren.

One has only to talk with Dr. Hogg for a moment or two to realize, however, that she is a most *extraordinary* grandmother. Hidden behind twinkling eyes and a warm, engaging smile is a razor-keen intellect with an astounding memory for scientific fact. To paraphrase a familiar cliché, she is a walking encyclopedia of astronomy, yet thoroughly at home in both the scientific and domestic environments.

After the customary formalities, Dr. Hogg ushered me into the spacious, comfortable office which has been her professional home since the early thirties. Evidences of astronomy meet the eye at every turn. Bookshelves containing formidable volumes and reports on astronomy line the wall behind the doctor's large oak desk. To her right, row on row of filing drawers contain the films and other scientific data accumulated over the years — the fruit of thousands of hours of lonely nocturnal vigils at the observatory's 74-inch reflecting telescope. A massive ceramic carving entitled *The Star Gazers* rests atop the desk.

As the interview got underway, I asked Dr. Hogg to outline her early career and how she came to be a professional astronomer. "Well," said she, "as a child, I was very much interested in the stars because my parents and an aunt who lived with us took me out and showed me the wonderful constellations, particularly Orion. At Mount Holyoke College, I took a course in astronomy with a most wonderful professor, Miss Ann Young, and she was so wrapped up in the stars herself, and made them seem so vital, that I knew I wanted to become involved also. I was in chemistry at the time but decided to transfer to astronomy.

"After obtaining a bachelor's degree at Mount Holyoke, I proceeded to Harvard Observatory on a fellowship. Harvard's director of astronomy at that time was Dr. Harlow Shapley who was the recognized world expert in the field of star clusters, and that was a field that right from the start had interested me. That was in 1926, and I am still working with the star clusters."

After this introduction, the interview continued:

Q. *Doctor Hogg, of what value is astronomy to mankind ?*

A. There are several points to consider here. One is that astronomy has some very practical values. One is time keeping. For several centuries time has been in the hands of astronomers. Although atomic clocks are coming in now, the source of their accuracy is astronomical time determination.

Another practical aspect is the effect of the sun on the earth's atmosphere, and on the people living beneath it. The sun has cycles of activity and is not just purring steadily along. The great solar flares that burst out and which are observed by astronomical instruments can give warnings of shortwave radio blackouts and other transmission difficulties. And a field that I think may assume great importance in the future is health. Such questions as what effect the state of the sun and the sunspot cycles have on the atmosphere and on the men beneath it. It seems to me that this is something which has not been sufficiently explored.

So these are practical things.

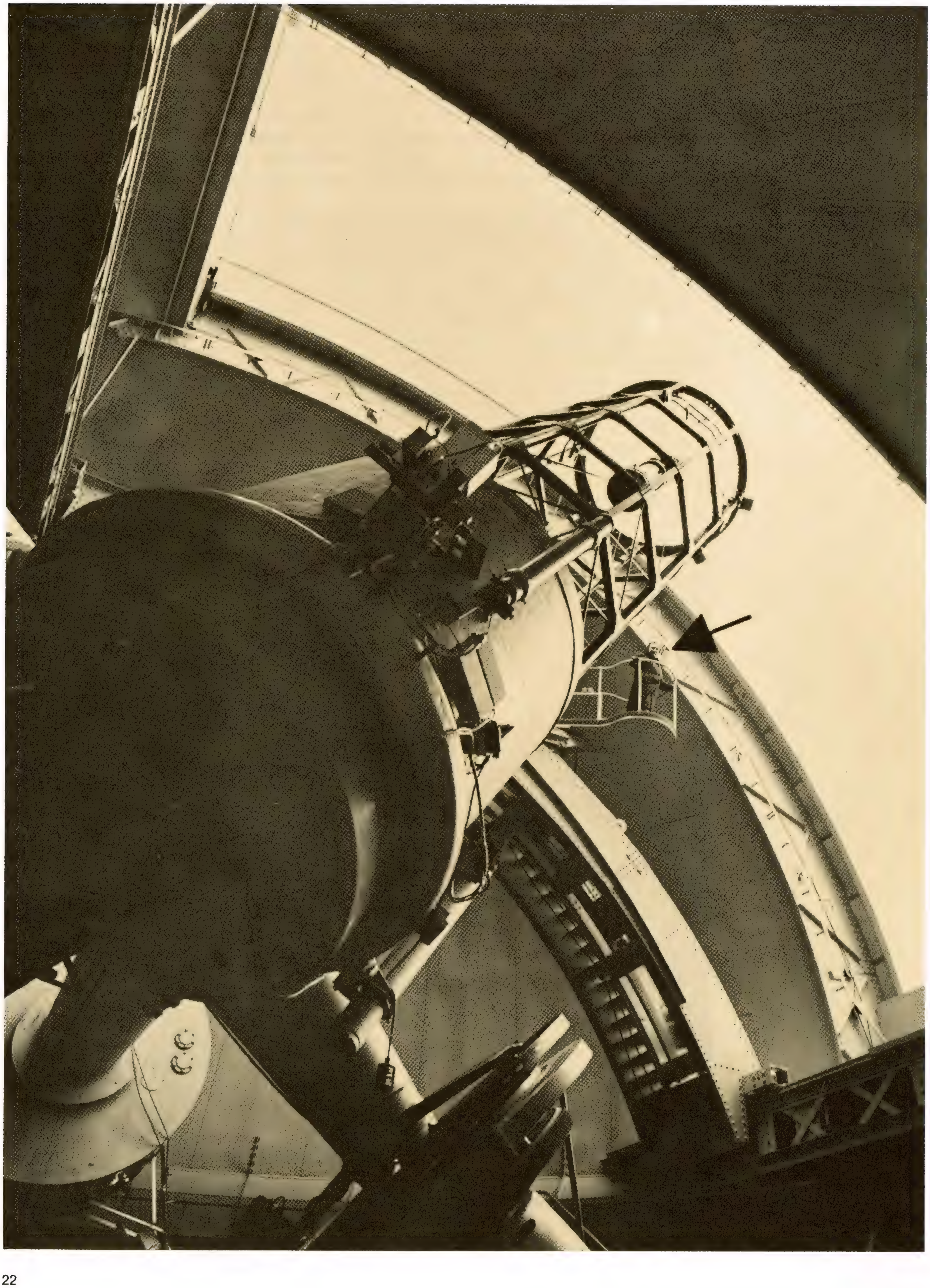
But I think for most astronomers the driving urge is simply to know more about this wonderful universe in which we live. It's such a *magnificent* universe yet so many people go through life really conscious only of what's happening on the surface of the earth. But this earth of ours is just one small segment in the universal pattern, and it just doesn't seem right for us not to look out and see what that pattern is and try to understand it. And you know, just a very few hours of astronomical lectures and the right kind of reading can give you an overall appreciation of the universe. You don't have to be an astronomer to get it, and I do think it helps people to get earth's trivialities into some sort of perspective. The universe is going to go on whether we're here or not — whether we blow ourselves up or not, the rest of the universe will just keep on going.

Q. *Do their observations of the universe incline astronomers more towards a belief in a Creator than other groups of people?*

A. No, I don't think this is necessarily so. I think that in their personal feelings astronomers are an average of most other people. In other words their studies wouldn't necessarily lead them to conclude there is or is not a deity, because this comes more in the realm of philosophy.

But one thing that I have concluded from my astronomical studies is that the heaven that people often talk about is really this earth as compared with any other body that we know about in the universe. Now mind you, there must be millions of other planets out beyond our solar system, but we don't know of a single place that has got such wonderful conditions for human life as this earth

2 - *The titanium-white dome of the 74-inch telescope at David Dunlap Observatory, Richmond Hill, Ontario. Entrance to Administration building appears in right foreground.*



3 - *This 74-inch reflector telescope was built in 1935 and was then the world's second largest. While it now ranks about eighth in size, it is still impressive, with its 30-foot length, its 25 tons of moving parts, and its two-ton, foot-thick disk of Pyrex coated with aluminum. Despite its venerable age, the telescope has modern electronic controls. Arrow points to Dr. Helen Hogg standing on Newtonian platform. Reaching this vantage point requires physical courage and stamina. But the doctor is an optimist, observing that "nobody need worry about falling from this place more than once."*

of ours. And so it is really heart-rending to see mankind messing it up the way it does. Here we've been given a heaven and look what we're doing with it!

Q. *How large is the universe ? Would you say it is infinite?*

A. The tendency now is to think of what is called a closed universe, and what really stops us observationally from going, as you say, to infinity, is that the most distant galaxies are receding from us at enormous velocities. Presumably when you get an object receding at close to the velocity of light you don't see it, and so that ends what we can see of the universe. Our observational limits now extend to about seven thousand million light-years. What lies beyond that we can only theorize.

Q. *Einstein's theory of relativity seems to figure prominently in astronomy. Do astronomers really understand it?*

A. Oh yes, very much so. And many mathematical and theoretical astronomers use his equations and work them into current theories.

Q. *Will astronomy of the future grow even more exciting?*

A. Well, I don't think you could say it will be *more* exciting because astronomy has always been very exciting. But it will probably be more spectacular as men go off in spaceships and establish orbiting observation platforms. These will provide better vantage points for future discovery, because they will not suffer from the distortions of the earth's atmosphere.

There are astronomers in training now in the U.S. awaiting an opportunity to join future astronauts. Eventually astronomers hope to have a 120-inch telescope up above our heads.

Q. *Doctor Hogg, as an astronomer, and also a director of Bell Canada, you are in a unique position to evaluate the possible interface between astronomy and telecommunications. Does such an interface in fact exist ?*

A. Yes, it certainly does. Satellites would be an obvious interface. And one of the most interesting areas of astronomy today is radio astronomy which came out of the work of Carl Jansky at Bell Laboratories in 1931-32.

He was working to find static on transoceanic circuits and he came up with static which was repeated and repeated in the period of the sidereal day which is four minutes shorter then the solar day. That periodicity showed that his static was beyond the solar system in the realm of the stars and indeed was coming from the Milky Way. Then just a few years ago, again at Bell Laboratories, Drs. Penzias and Wilson noted an excess of antenna temperature of about three degrees with their supersensitive equipment. This is a fantastic thing, the explanation of which is almost eerie. According to the Big Bang theory of the origin of the universe, there was some heat and radiation left lying around in space after the great explosion. Theoreticians such as George Gamow felt there ought still to be a trace of this background radiation in the universe today, eight thousand million years later. The three-degree excess antenna temperature discovered by Penzias and Wilson is now regarded by some as proof of this.

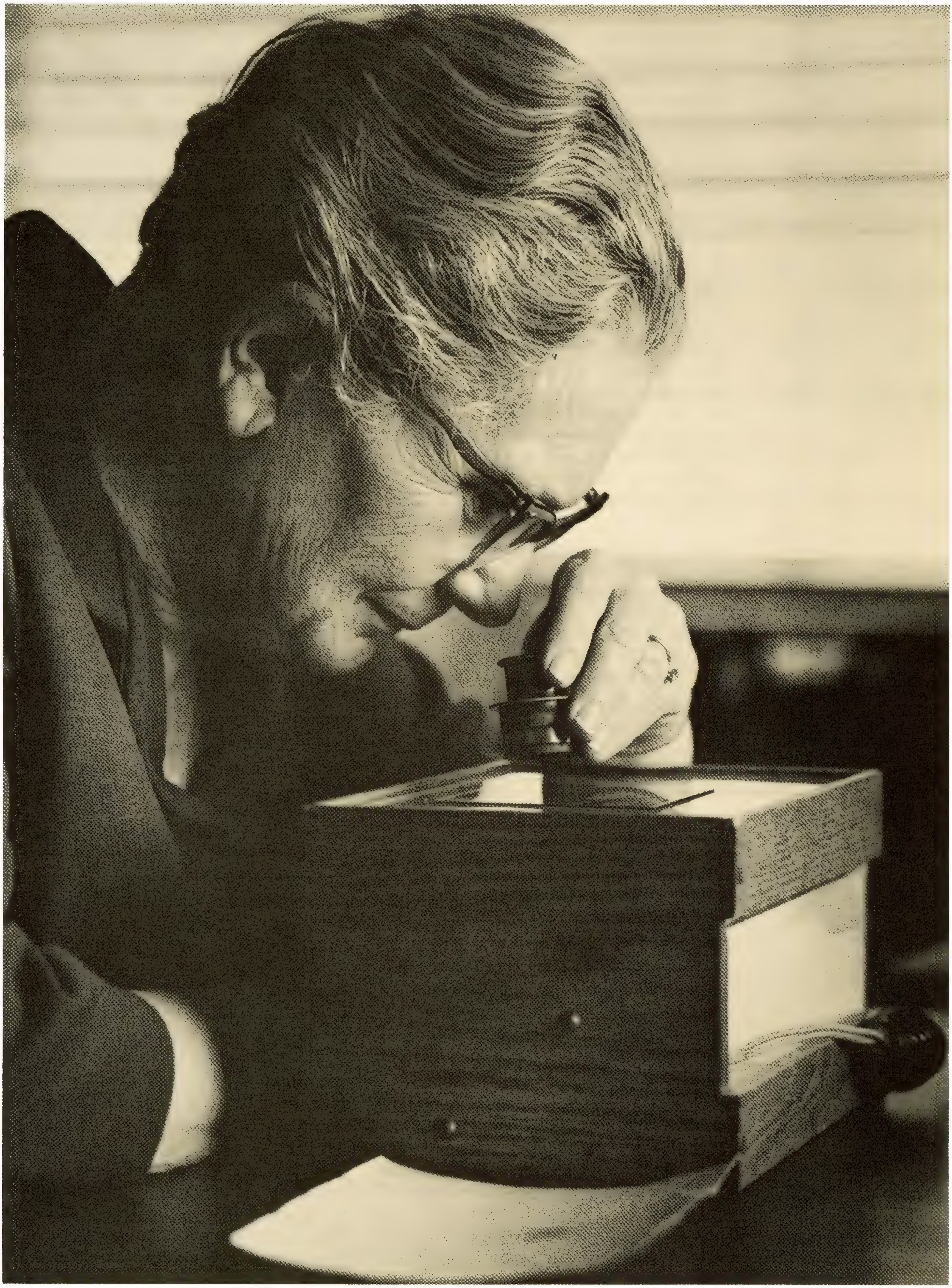
Q. *Doctor, your area of specialization is variable stars. What are variable stars ?*

A. By the term variable star we mean a star which varies in light. Now there are other characteristics of a star that vary also. One is its spectrum. Another is its motion. But the term variable star usually refers to a star whose light varies. Some may take a year to go through their variation and may be more than a hundred times as bright one time as another; others may vary in the course of only a few hours. Over 20,000 variable stars have been identified — only a relatively small portion of those presumed to exist. They are in a stage of their existence — in a so-called instability strip. Eventually they will settle down to being steady stars. Our own sun may once have been a variable star, though this is not known for sure.

Q. *And in what way does a knowledge of variable stars assist science ?*

A. Firstly, such knowledge is useful in determining distances to the clusters in our own galaxy and hence in determining the size of that galaxy.

Secondly, the behaviour of the variables is giving us more and more clues to the evolutionary processes of the stars. Some of these are quite fundamental. For example, it was through a knowledge of the sun and the stars that Hans Bethe developed atomic nuclear fission.



4 - *Dr. Hogg, at a table in her office, studies a photographic slide taken of one of her favourite variable stars.*

Nuclear energy is what keeps the sun and the stars going, and the variable stars being at an uneven part of their life cycle can give us different and at times more valuable clues than the steady stars.

Q. *Doctor, what are the educational requirements to become an astronomer?*

A. A good foundation in maths and physics is essential. Some would say that undergraduate courses in astronomy are necessary to succeed at the graduate level, but I don't think this is necessarily the case. Without a facility in maths and physics, however, a person will never become a professional.

Q. *Is it necessary to be an honours student ?*

A. Usually, but not always. To become a teaching astronomer on the staff of a university you need a doctorate, and that usually means starting from an honours course.

Q. *Are astronomers well paid ?*

A. As measured against the yardstick of business executive salaries, possibly not. But there has been a big change in the past ten or twenty years in the academic world. Back in the Twenties, professors in astronomy were proud of their low salaries — your job was so wonderful, you really didn't need to get paid much for doing it, some theorized. Since the Second World War, however, astronomers have been considered worthy of their hire and are generally paid according to professional standards.

Q. *What other satisfactions does astronomy hold out for the professional ?*

A. The satisfactions derived from exploring the unknown can be tremendous. In my own case, for example, I find it difficult to explain the wonderful feeling of elation that I get from making a discovery, and being able to say "nobody on earth ever knew this before". It's really quite indescribable.

Q. *Dr. Hogg, one thing we haven't discussed yet that is on many people's minds these days concerns the possibility of life on other planets. Do you think such a possibility exists ?*

A. Yes, I think it is quite possible. There are a hundred thousand million stars in our galaxy alone, not to mention the countless other galaxies in the universe. The problem in verifying this, however, lies in the vast distances to be covered. Some years ago a U.S. astronomer did a computation based on the number of stars in our galaxy, the distances between them and the average life span of a technical civilization to determine how far out we would have to go to reach a civilization in a stage of development comparable to our own. He concluded that the average technical civilization is probably about 800 light-years away. This means that even if astronomers could devise instruments powerful enough to reach that distance, it would take 800 years for a signal travelling at the speed of light to reach the other civilization and another 800 years for their reply to come back. People who complain about telephone service might be effectively silenced if they were to contemplate communications in terms of this magnitude.

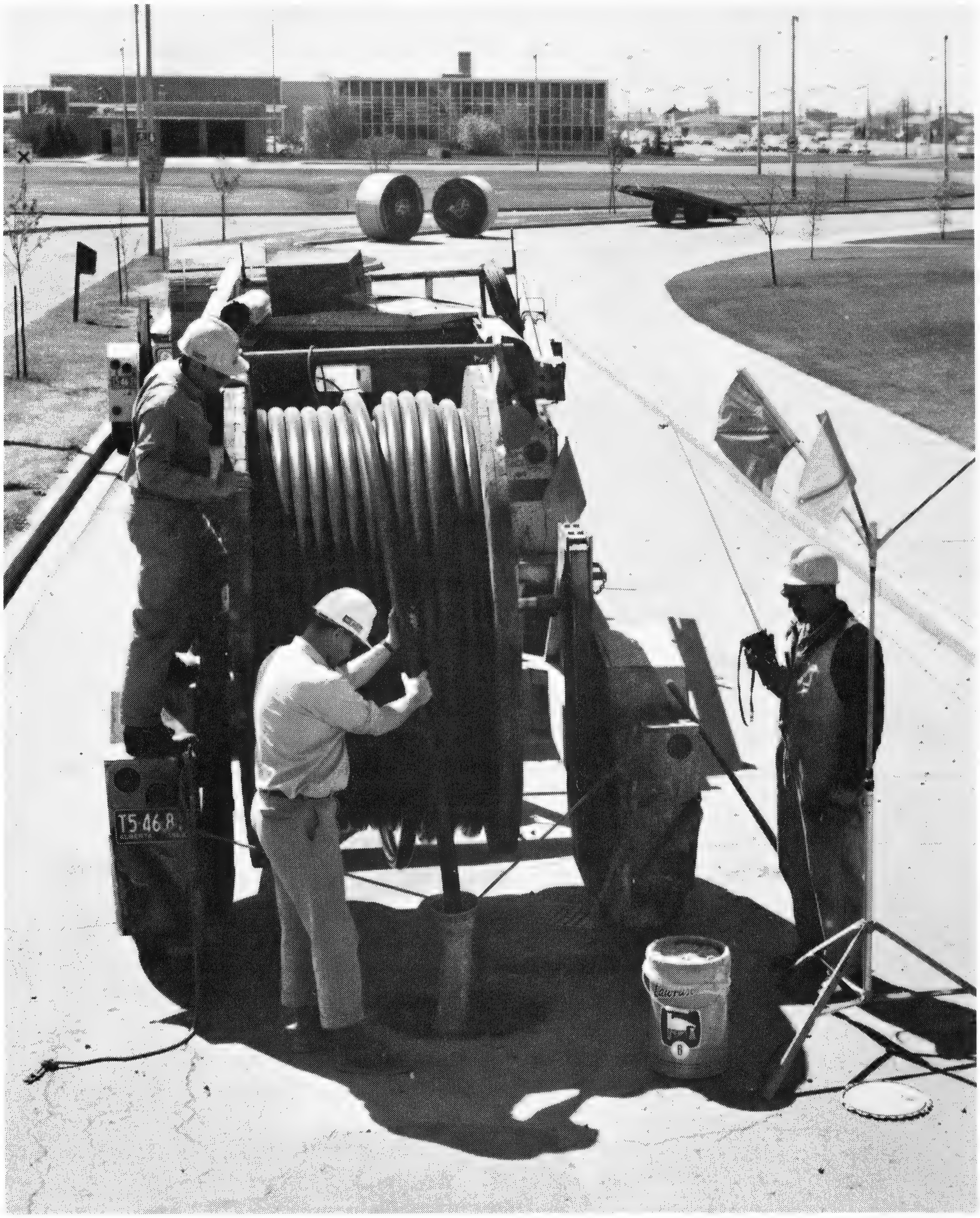
But it is also possible that civilizations exist on planets within 8 to 10 light-years, so we should not despair of some day making contact. Nowadays science seems more fantastic than fiction.

Coaxial cable for Alberta

by W.A. Wardrop

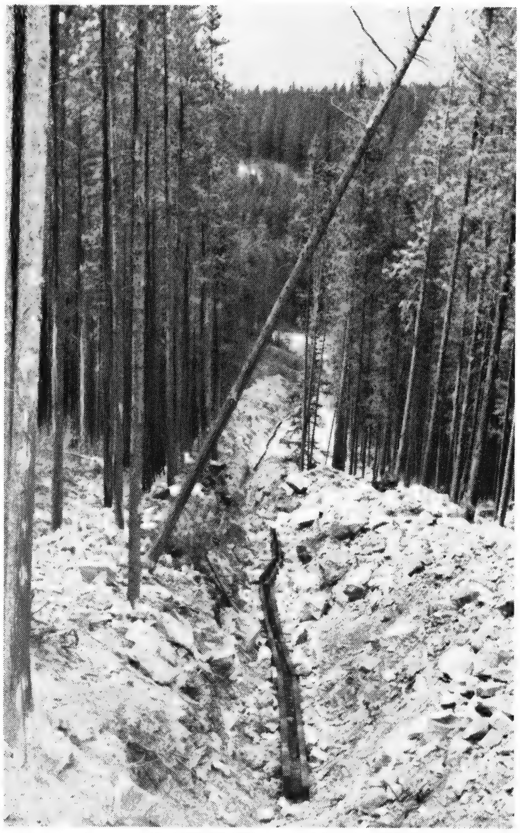
Northern Electric coaxial cable was introduced into the Alberta Government Telephones' system in 1965 when a 57-mile link of CAN-63 was buried between Red Deer and Rocky Mountain House. When first installed, this link carried 88 voice circuits. Today, the number has risen to 126 and has still a long way to go before reaching its full capacity.

The success of this first venture has led to more of this type of cable being used throughout Alberta. Coaxial routes have been buried between Lethbridge and Coutts, Edmonton and Wildwood,



1 - *Near Sherwood Park, linemen guide coaxial into underground conduit.*

2 - *Blasting crews working on Sulphur Mountain near Banff cleared a three-foot trench 6500 feet long. Wooden duct was laid to protect cable.*



Edson and Jasper, Calgary and Banff, and within the City of Edmonton. AGT now have 450 miles of N.E. coaxial cable in conduit and underground.

In all of these installations, except Edmonton, a two-, four-, six- or eight-tube CAN-63 cable has been used. In Edmonton, one of the largest PD-375 coaxial cables ever used in Canada, consisting of 18 tubes and measuring 2.5 inches in diameter, was brought a distance of 7.8 miles from Sherwood Park on the eastern boundary of the city to the toll office located in the heart of the downtown area. Highrise construction in the city would ultimately block the microwave route into the downtown area and this consideration has necessitated the alternate method of toll and TV transmission. Each pair of tubes can carry up to 1200 voice circuits at a time with the present electronic equipment. Initially, only six tubes, will be in use with the rest kept in reserve for the future.

Besides the installation of the cable through conduit, the project involved the building of a radio terminal building and a 275-ft. tower near Sherwood Park and a repeater station in the Ottewell district. The radio relay station at Sherwood Park will contain radio terminal equipment relocated from the TD-2 site in Edmonton.

AGT construction crews moved into the Banff area last summer to commence installation of one of the most complex CAN-63 coaxial cable projects in the Province. The project, which will replace the presently congested toll facilities, will eventually provide a coaxial carrier system capable of 240 channels from Calgary to Lake Louise.

Construction crews have been faced with major problems in burying the cable. The route near Banff is almost solid rock, and 6,500 feet are being buried on Sulphur Mountain. Blasting crews have been working in the area and have cleared a trench three feet deep. A wooden protection duct will encase the cable.

The first phase of the project, the Calgary-Banff section, will be turned up this spring. Total cost of this phase will be $1,670,000, cable accounting for $400,000. of this amount.

There is no simple answer to the question of what type of transmission system is best, but coaxial cable has many plus factors in its favor. It has the capability of a wide base band, and is therefore more practical than standard types of cable which have only a limited band of frequencies.

AGT has buried all its coaxial cable making it less susceptible to storm and other forms of surface hazard. Another important factor is that the room for microwave on the radio spectrum is rapidly being used up, but there is still plenty of ground left for buried cable.

In aid of the developing countries

by M.V. Duffey

What one Canadian organization is doing to narrow the gap between the world's affluent and developing countries.

Today protest groups abound at every turn. The trouble with many of them is that they are not committed to a constructive re-ordering of society. They are cursing the darkness, but not lighting any candles.

Fortunately, to counterbalance these, there are organizations devoted not to protest, but to *involvement.* One such is Canadian Executive Service Overseas, known familiarly as CESO.

CESO is the retired man's version of Canadian University Service Overseas (CUSO) and fills an important gap between that organization and the larger programs administered by the Canadian Government's External Aid Office with whose assistance CESO was formed.

CUSO sends young university graduates into the developing countries to help out in situations where their knowledge is useful though their experience is limited. These graduates stay for two years and are paid the "going rates" applicable to the countries in which they work.

CESO functions at the opposite end of the spectrum — its volunteers are generally retired executives and professional people. After years of on-the-job experience, they work for periods of up to six months as consultants or to update existing managers in response to specific requests from developing countries. They are not paid for their work, but receive travel and living expenses for themselves and their wives. Their stock-in-trade is know-how, the cumulative knowledge and experience garnered over long careers at middle and senior levels in business and the professions.

The need for CESO

Explaining the need for its services, Cyril A. Peachey, retired executive vice-president of Northern Electric and now executive vice-president of CESO, says: "A statistic that people either don't realize or tend to forget is that one third of the world, approximately 1 billion people living mostly in the North Temperate Zone, have most of the world's capital, technology, skills, medical knowledge and affluence. More than 2 billion others have little or none of these. And what makes the situation worse is that the gap between the two groups is widening. There'll be no lasting peace in the world unless countries like Canada do their share to help less affluent peoples raise their standards of living."

"And", Mr. Peachey continues, "the important thing to remember is that money alone won't solve the problem. As those involved in such aid programs so well know, the beneficial effects of monetary give-aways can be largely dissipated if not supplemented through provision of appropriate technical know-how. It is in this latter area that CESO can make its greatest contribution".

CESO is a non-profit corporation formed in 1967 by Canadian business leaders. While not a government agency, it operates with the support of the Federal External Aid Office.

CESO functions as a sort of specialized employment agency, recruiting a pool of expert volunteers who can be made available for assignment in countries with a need for specific talents.

Executives at CESO headquarters such as Mr. Peachey visit developing countries and explain the CESO service to government officials, to manufacturing associations, Chambers of Commerce and other organizations who may be interested. It is a soft sell process and CESO acts only in response to specific requests from these countries. CESO then endeavors to recruit specialists qualified to undertake the assignments.

The CESO roster

At present CESO has an enrollment of over 400 former executives and hopes to build this number up to around 1000 retired and semi-retired volunteers.

Increasing its talent bank is one of CESO's major activities today. The present volunteer list, while fairly broad in scope, does not allow the organization to be as fully effective as it would like to be because of gaps in much-needed specialties. Critical path planning and computer technology, for example, are such relatively new fields that few retired experts are yet available. Not surprisingly, however, these are fields of special importance to developing nations.

Says Colin Campbell, a former vice-president of Clark Foods Ltd., now in charge of CESO recruiting: "The trend in many corporations toward earlier retirements is producing a solid group of highly qualified people, many of whom are at the height of their capabilities. These people are not content to spend their remaining years on the golf course. They are able and want to make a meaningful contribution toward resolving some of the problems besetting our societies. CESO gives them the opportunity."

Cy Peachey looks forward to the day when companies might be willing to loan active employees for periods of three or four months at a time to handle specialized assignments. "It should prove to be a valuable experience for the employee and he should return to his company stimulated by a whole series of new inputs. He should return broadened in outlook and be able to make a more valuable contribution to his company."

Locating volunteers

To help recruitment, CESO has launched an aggressive program to get its message across to as wide an audience as possible in Canada. Contact has been established with professional organiza-

1 - *Members of CESO executive regard the world as their back yard. CESO has been called "the retired man's Peace Corps." From left to right: Cyril Peachey, executive vice-president; Jean-Claude Hébert, president; Ken Doig, vice-president; Walter Eversfield, vice-president and treasurer.*

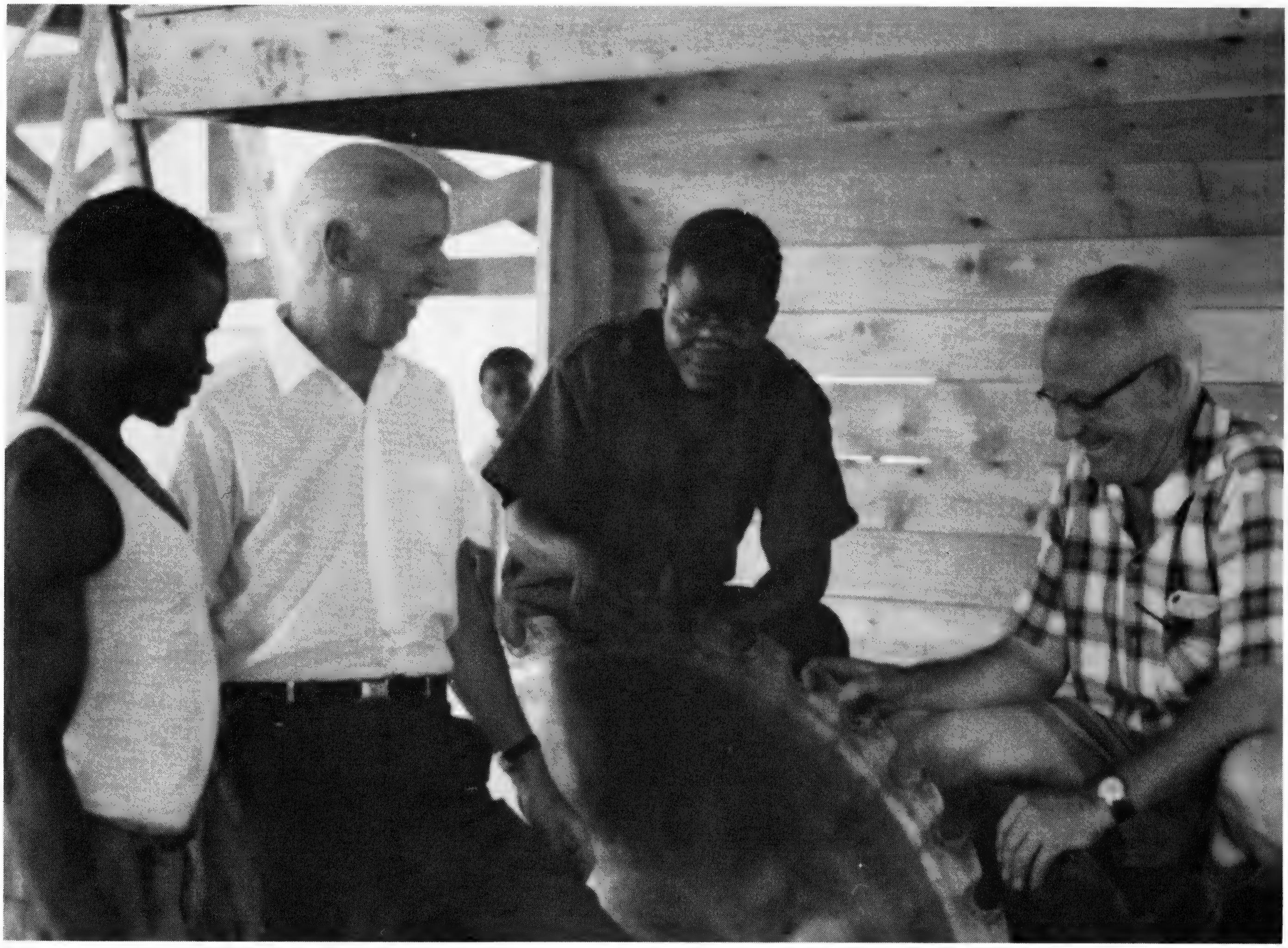
tions such as the Canadian Medical Association, the Canadian Personnel Institute and the Engineering Institutes. But by far the most valuable aid to CESO's recruiting is the organization's Board of Directors. Numbering more than 100, it reads like a *Who's Who* of Canadian enterprise. Every member is chairman or president of his company, and almost every field of endeavor is represented. While not expected to function in an administrative capacity, the directors provide direct contact with the executive suites of a large number of Canadian corporations — the principal source of CESO volunteers and financing. Among the directors are Marcel Vincent, Chairman of the Board of Bell Canada, and R. Holley Keefler, Northern Electric's Chairman of the Board.

Typical projects

In 1967, Mr. Peachey spent several weeks visiting Kenya, Zambia, Tanzania, Malawi and Uganda and returned to Africa and the Caribbean in 1968 to explore the potential for CESO's services. President Claude Hébert has travelled to Senegal, Ivory Coast, Ghana, Tunisia, Indonesia, Pakistan and Malaysia. Trips to South America have also been made. From such visits it is evident that there is a strong need for managerial talent combined with technical knowledge and ability. No particular industries stand out in this respect although food and agriculture are two areas which have been assigned high priorities by the countries concerned.

A typical example of an assignment is that of John A. Hatch who had built up a trucking and autobus business in British Columbia. He recently retired as active head of his company and went to Nairobi, Kenya to assist a trucking and bus corporation there. He spent close to two months in Nairobi and was able to impart a lot of his know-how to the operating people in Nairobi.

Another example is that of C.E. Turner, retired vice-president of Kruger Pulp & Paper. Mr. Turner is presently filling a three-month assignment improving pro-



2 - *Cy Peachey visits a sawmill in Zomba, Malawi. Russell Johnson (in plaid shirt), who owned and installed Ontario sawmills during his active career, gives technical advice to Malawians.*

duction in a pulp mill and paper mill in Pindamonhangaba, Brazil.

Many of the assignments undertaken by CESO volunteers follow a similar pattern, i.e. the volunteer studies a problem area and then makes recommendations to the responsible authority. CESO lists the tasks it is prepared to undertake as anything from tuning up an existing operation, making a feasibility study, and analyzing a given problem area, to the development of training programs and acting as replacement executives in the absence of a local official.

Some of the requests received concern particularly narrow specialties and present a real challenge to CESO recruiters. Recently, for example, they were asked to locate a volunteer bee specialist and a leprosy technologist. Neither of these two categories was represented in the talent bank but, after some searching, CESO came up with an aircraft executive who for forty years had made a hobby of beekeeping. The leprosy technology expert took longer to locate but was eventually found on CESO's doorstep at the University of Montreal.

Satisfactions can be great

It is not uncommon for executives returning from assignments to observe that the satisfactions they have derived have exceeded those experienced over long working careers. Their wives seem to feel the same way.

CESO volunteers are cautioned, however, not to count on all the comforts and conveniences of home when they travel abroad. A measure of sacrifice, or at least some adjustments in living standards, can be expected. But differences in customs and facilities do add an element of interest and give volunteers an opportunity to broaden their knowledge and understanding of the politics, social customs, traditions and religions of various peoples.

As CESO officials point out, it is important for both the man and his wife to be tolerant about the politics, traditions and religious practices existing in the country. It must be remembered that many of the developing countries are not particularly orientated to Western philosophies. No amounts of goodwill and material aid are adequate substitutes for understanding and sensitiveness to the values that another country holds dear. Canadian efficiency, purposefulness and enthusiasm for material success can be irritating and even incomprehensible to some of the people in developing countries.

It is obvious then that the CESO volunteer must be a special kind of person: one who combines technical knowledge with the right proportion of those human qualities so essential in getting along with other people. Not all applicants are placed on the volunteer list. But for those who do qualify and who accept assignments, the rewards in terms of personal satisfaction and accomplishment can be great.

Further information on CESO and how to apply for volunteer service can be obtained by writing to: CESO, 1010 St. Catherine St. W., Montreal. CESO also has representatives in Toronto (C.E. Soward, 14 Oriole Gardens, Toronto 7) and Calgary (E. Connelly, 1135 Beverly Blvd., S.W., Calgary).

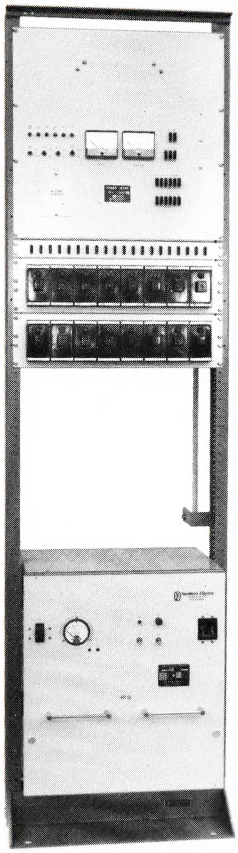
Products

a) PH-1 Power Plant

Northern Electric's PH-1 is a solid-state power plant designed to provide 48-volt positive or negative service for Step-by-Step, Crossbar, Toll, or Electronic Switching Systems.

The PH-1 consists of a control panel, discharge fuse panels, and 48-volt silicon controlled rectifiers. It is designed to operate at a discharge voltage of 50 to 52 volts up to a normal maximum capacity of 400 amperes. Standard discharge capacities available are 60, 200 and 400 amperes. Dry CEMF cells, normally mounted on a battery stand, can be relay rack mounted if preferred. CEMF control is optional. Alarm indications are given for high and low voltage, and for failure of fuses, rectifiers, and CEMF cells.

The PH-1 equipment mounts on 23-inch channel type relay racks; the normal height being 7 feet. Other bay heights, in 6-inch increments, can be supplied to a height of 9 feet.



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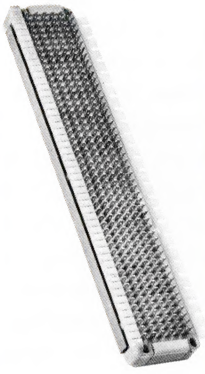

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b) NE-714QA Tool

The NE-714QA tool is used to terminate conductors on NE-66 type connecting blocks. The tool consists of a 4-headed steel blade having two cutting and seating heads attached to a yellow and green plastic handle. The blade has two restrictive heads, and two non-restrictive heads. Restrictive heads are used to seat, or to seat and trim conductors on blocks with phosphor bronze type clips. Non-restrictive heads are used on terminals mounted in the new, light green coloured, NE-66 type blocks. Blade heads are located at 90 degree intervals and the selected head is made accessible by loosening a holding screw and rotating the blade. The diametrically opposite head enters into a locating hold to stabilize the blade and the adjacent heads are fully protected by the handle.

c) NE-66 Type Connecting Blocks

The NE-66 type connecting blocks, coded NE-66Q6A-25 and NE-66Q3B-50, are ready access building terminals which provide terminating points for 25- and 50- pair lead-in and feeder cables. The blocks are light green in colour and feature an improved quick-connect terminal which is made from a base metal that is of higher tensile strength and less susceptible to fatigue than the phosphor bronze type terminal. The terminal design includes an *insulation-slicing* feature which provides an improved method for penetrating the insulation on unskinned 19-26 gauge wires. Fanning strips on the NE-66 type blocks are provided with a *write-on* surface that accepts pencil markings for pair identification.

Blocks mounted in compact metal housings, coded NE-66Q6B-25 and NE-66Q6B-50, are also available.

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